

Appl. No. 10/517,877
Amtd. Dated October 4, 2007
Reply to Office Action of April 4, 2007

REMARKS/ARGUMENTS

Applicants respectfully request reconsideration of the prior art rejections set forth by the Examiner under 35 U.S.C. sections 102 and 103. Applicants respectfully submit that the prior art references of record, whether considered alone, or in combination, fail to either teach or suggest Applicants' presently claimed invention.

More specifically, Applicants present invention is directed to overcoming the deficiencies of the prior art wherein it was discovered that crystal dislocations in the core portions of the gallium nitride substrate material propagate into the region of a multilayer gallium nitride-based compound semiconductor layer structure. This is a high-density defect region where electrical resistance is low. As illustrated in Fig. 12, the high-density defect region over the core portion is not epitaxially grown unlike other portions of the multilayer gallium nitride-based semiconductor structure. As a result, a silicon dioxide film formed under a pad 37 as a locally thin region. As a result, injection current does not contribute to light emission but rather flows from the pad metal 37 through the high-density defect region in the multi-layer structure to the gallium nitride substrate 46. Therefore, this results in a failure to provide laser oscillation. See, for example pages 14-15 of the instant specification.

The inventors have discovered that by making sure that the pad metal does not extend over the high-density defect region improved performance can be achieved.

For the purpose of clarification, Applicants have modified independent claim 1 and additionally, Applicants have added new independent claims 11 and

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12. Independent claim 1 now specifies that the electrode is provided on the multilayer structure in a region such that it does not overlap in the depth direction any portion of the core portion of the substrate. Claim 1 also specifies that the pad metal extends beyond a lateral edge of the electrode and the pad metal does not overlap in the depth direction any portion of the core portion.

Therefore claim 1 very clearly articulates that the pad metal extends over the electrode beyond its edge to a region which does not have a high density of defects. The prior art Yamaguchi reference merely describes a structure wherein the defect free region is found exclusively under the electrode and no pad metal is provided which extends beyond the boundaries of the electrode to a region having a low density of defects.

New independent claim 11 also clearly specifies that the pad metal extends beyond a lateral edge of the electrode and the pad metal does not overlap in the depth direction any portion of said core portion. Finally, new claim 12 has been added which alternately specifies that a second electrode is formed over the GaN substrate adjacent to the multilayer structure and wherein the low-density defect region of the substrate extends continuously from a region beneath an outer portion of the pad metal to the region beneath the second electrode.

None of the references cited by the Examiner, whether considered alone, or in combination, teach or suggest this advance in the art. At best, the Yamaguchi reference merely describes a gallium nitride-based structure wherein a low-density defect region is found exclusively in the area that is perpendicularly beneath the boundaries of the electrode. None of the remaining references teach or suggest that this defect free region should extend at least

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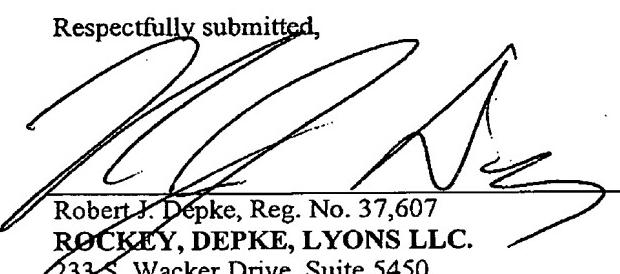
beneath an outside boundary of a pad metal formed over the electrode and furthermore there is no teaching or suggestion regarding the defect free region extending continuously from the region beneath the pad electrode to the second electrode as specified in new claim 12. Yamaguchi cannot provide such a structure as a result of the way in which the crystalline material is grown which results in numerous high-density defect regions formed throughout the structure. The remaining reference was only cited for its disclosure of a pad metal.

Accordingly, in light of the foregoing, Applicant submits that all claims now stand in condition for allowance.

The Commissioner is hereby authorized to charge any fees due or to credit any overpayment to Deposit Account No. 50-3891.

Respectfully submitted,

Date: 10/4/07


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